

NWS FORM E-5 COMMERCE	U.S. DEPARTMENT OF	HSA OFFICE: <b>San Juan, PR (SJU)</b>
SERVICE	NOAA, NATIONAL WEATHER	REPORT FOR (MONTH / YEAR): <b>November , 2004</b>
<b>MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS</b>		DATE: <b>December 2, 2004</b>
TO: NATIONAL WEATHER SERVICE HYDROMETEOROLOGICAL INFO CENTER, W/OS31 SSMC 2 – Room 13468 1325 EAST-WEST HIGHWAY SILVER SPRING, MD 20910-3283		SIGNATURE: Peter Corrigan
When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (WSOM E-41).		

**Summary:** November 2004 was extremely active during the first half of the month month, with flooding and landslides in some locations nearly as bad as November 2003. Fortunately the last third of the month turned much drier, providing a welcome respite. There was one flood and one landslide fatality, along with considerable damage from flooding and landslides. At San Juan ASOS, rainfall amounted to 5.82" or 0.35" below normal. This was only about half the rainfall of November, 2003. At St. Thomas, USVI (Truman Field) 5.86" fell versus a normal of 5.28".

The month began with heavy rainfall during the early morning hours of the 1 November, which prompted reissuance of a Flash Flood Warning from the night before in 6 municipalities from San Juan east to Rio Grande. Later, an additional 23 municipalities in the eastern third of the island were put under an Urban Small Stream Flood Advisory. Another line of storms developed around mid-morning and moved across parts of the San Juan metro area, producing some urban flooding and requiring an Urban Small Stream Flood Advisory for several municipalities. A moist, unstable air mass remained in place across Puerto Rico on 2 November, providing favorable conditions for more convection, this time centered primarily over the southwest interior. One to three inch rains fell over this area, with isolated radar estimates of up to 4 inches over northern Guayanilla and Yauco municipalities. An Urban/Small Stream Flood Advisory for 14 municipalities was issued, although no reports of flooding were received by the NWS. Much drier and more stable air filtered into the northeast Caribbean on 3 and 4 November, with precipitable water falling to only 1.14" by 00Z during this period. Shower activity was practically nil during these days.

Several weak disturbances moved across the area on the 6 and 7 November, coincident with a steady increase in moisture. Urban and Small Stream Flood Advisories for 7 municipalities in the northwest were issued late on the 6 Nov., due to estimated rainfall of 2 to 3 inches. The activity on 7 November was more sporadic with only 3 advisories issued, in the far west and over Arecibo. The heaviest rains actually occurred over parts of the Rio Grande de Loiza basin, with 2 to 3 inches estimated by radar. A strengthening upper trough on 8 November brought an increase in moisture (PWAT reached 2.05" by 12Z on 8 Nov.) and more widespread shower activity. St. Thomas was put under an Urban and Small Stream Flood Advisory in the morning as 1 to 2 inch rains moved across the area. Heavier rainfall of 1 to 3 inches, with isolated amounts reaching 4 inches, pushed across the far southeast during the late morning, especially over Humacao, where another Flood Advisory was posted. Bands of showers moved across the north

central island during the afternoon affecting primarily Vega Baja west to Arecibo and prompting a Flood Advisory for six municipalities. Synoptic scale factors pointed to the development of a significant flooding event across Puerto Rico and the U.S. Virgin Islands beginning on 9 November, prompting the issuance of a Flood Watch for Flash Flooding. Factors included a deep mid to upper level trough over the western Atlantic Ocean, strong jet energy, substantial divergence aloft and surface low pressure combined with abundant low and mid-level moisture. Substantial shower activity in the overnight hours of the 8-9 Nov. moved over the U.S. Virgin Islands, Culebra and Vieques. An Urban Small Stream Flood Advisory was issued for the latter islands during the evening and extended to the Virgin Islands in the early morning. 24-hour rainfall totals at 1200 UTC on 9 Nov. reached 3.30" at Charlotte Amalie (XTCP4); 2.40" at Utuado (UTLP4); 2.35" at Las Piedras (PIEP4) and 2.20" at Rio Mameyes near Sabana (MSAP4). The development of low pressure to the south failed to move as forecast on 9 Nov., as the low and associated heavy rainfall remained well to the south of Puerto Rico. Heavy rains skirted the northern coast of Puerto Rico on 10 Nov., with a few coastal locations receiving an inch of rain, but little over the interior. The Flood Watch that was in effect for much of the week was lifted early on 11 November as it then appeared that the most significant activity would remain to the east of the islands.

However, the persistent upper trough to the west of Puerto Rico and the extremely moist low level air mass (nearly saturated from 600 mb to the surface) shifted slightly westward early on 12 Nov., bringing much wider coverage of showers. By 1200 UTC on the 12 Nov. rainfall was already fairly impressive, with 2.73" at Represa de Comerio (CMRP4); 2.66" at Aguas Buenas (BZBP4), 2.59" at Rio Canas (CAPP4) and 2.40" at Naranjito (NAMP4), along with numerous 1 to 2 inch rains over the northeast quarter of Puerto Rico. The heavy rainfall prompted issuance of an Urban and Small Stream Flood Advisory around the San Juan metro area, after reports of flooding in a residential area of Toa Baja were received. Reports of flooding were received along the Rio Cibuco in Vega Alta, Sector Fatima, prompting issuance of a Flood Warning for that river. Moderate to occasionally heavy rains persisted throughout much of the day under strong north to northeast surface flow that produced substantial orographic enhancement over the foothills and mountains of central and eastern Puerto Rico. Rainfall intensity remained fairly low, but the persistence produced impressive totals in these areas, with 3 to 6 inches across a huge swath of central Puerto Rico for the 24 hours ending at 1200 UTC on 13 November (see Table 1 below). Flood Warnings for rivers basins draining north from the mountains, including the Rio Grande De Arecibo, Rio Grande De Manati, Rio De La Plata and Rio De Bayamon were issued early in the day and remained in effect for up to two days in some locations. Crest forecasts were complicated considerably by the high surf and north winds along the coast which hindered normal discharge of rivers into the sea. The activity continued to be widespread and intense on 13 November as a Flash Flood Warning was issued toward mid-morning for 14 northeast municipalities from Fajardo southwest to Gurabo and Juncos. Reports of flash flooding became more numerous throughout the day and another Flash Flood Warning was issued for 7 municipalities in the central mountains in the afternoon. This warning was extended in the evening as moderate to heavy rainfall persisted across the same area. Numerous landslides were also reported at this time, especially in Cayey, Aguas Buenas and Naranjito. Bridges were reported overtopped, collapsed or washed out in several locations, including Naranjito, Orocovi, Morovis, Aguas Buenas, Cidra, and Utuado. Another Flash Flood Warning was issued for Dorado and Toa Baja, primarily in the highly saturated Rio De La Plata basin during the evening. 24-hour rainfall ending 1200 on 14 Nov. was very similar to the previous day's total, with highest amounts, in excess of 5 inches, centered in the area around Comerio, Aibonito and Aguas Buenas.

November 14 saw little break in the rainfall activity as the upper trough remained stationary to the west of the island and the very strong and moist northeast flow

continued advecting showers across the island. Rainfall intensity remained moderate throughout much of this event, with hourly amounts rarely exceeding one inch and often remaining below 0.5 inches. Nonetheless, the persistent moderate rainfall appears to have been ideal for the production of landslides around the island. Landslides covered numerous roads and several damaged or collapsed bridges were also reported. Around 1700 UTC on 14 Nov. a landslide in Adjuntas, Barrio Yahuecas, pushed a vehicle with three persons into the Rio Blanco, causing a 28-year old man to drown and injuring two young women. A direct flood death occurred in Guaynabo around the same time when a 74-year old women was reportedly swept into the Rio Guaynabo, a tributary of the Rio De Bayamon. Her body was recovered five days later. Meanwhile, Flood Warnings remained in effect for many of the river basins draining the northern slopes of the central mountains. The most intense rains on 14 November occurred over the east central and southeast parts of the island, prompting a Flash Flood Warning for 10 municipalities in that region. During the late afternoon overnight hours of 14 November the heaviest rains fell across the Culebra, Vieques and the U.S. Virgin Islands, prompting several Flood Advisories and a Flash Flood Warning for St. Croix.

Flood Warnings along the Rio Cibuco, Rio De La Plata, Rio Grande De Manati and Rio Grande De Arecibo continued into 15 November, as the strong onshore flow continued to restrict outflow of these rivers into the Atlantic Ocean. Rainfall amounts were much less than previous days however, with only isolated amounts in excess of one inch and many locations dry for the first time in nearly a week.

**Table 1. 24-hour rainfall and 4-day storm total ending at 1200 UTC:**

Station Name (NWS ID)	Nov 12	Nov 13	Nov 14	Nov 15	Total
Rio Icacos nr Naguabo (NGIP4)	2.23	4.63	6.12	4.24	<b>17.22</b>
Lago Icacos at Damsite (LICP4)	1.84	4.47	5.37	3.97	<b>15.65</b>
Boca Grande nr Jayuya (JACP4)	1.67	6.41	3.25	3.33	<b>14.66</b>
Represa De Comerio (CMRP4)	2.73	4.62	5.55	1.51	<b>14.41</b>
R. De La Plata - Comerio (COMP4)	1.82	5.47	4.88	1.15	<b>13.32</b>
Bairoa Arriba RG (BZBP4)	2.66	5.49	3.71	0.81	<b>12.67</b>
R. Guadiana nr Naranjito (NMAP4)	2.40	4.63	3.93	1.68	<b>12.64</b>
Aibonito Coop (ALPP4)	1.20	4.20	5.80	1.03	<b>12.23</b>
Rio Bauta - Orocovis (BAUP4)	1.05	6.15	3.15	1.84	<b>12.19</b>
Bo. Mamays Ab. nr Jayuya (JABP4)	1.28	4.93	2.59	2.42	<b>11.22</b>
R. Limon ab. L. Dos Bocas (ARHP4)	1.23	3.89	3.13	2.89	<b>11.14</b>
Bo. Saliente nr Jayuya (JAZP4)	0.96	4.50	3.08	2.46	<b>11.00</b>
Bo. Fronton nr Ciales (CIBP4)	1.08	4.79	2.67	2.31	<b>10.85</b>
R. Caonillas at Paso Palma (JAXP4)	0.85	5.43	2.40	2.16	<b>10.84</b>
Rio Orocovis at Orocovis (RORP4)	0.72	4.99	2.55	2.18	<b>10.44</b>
Rio Bayamon at Arenas (CIFP4)	0.51	4.11	4.57	0.76	<b>9.95</b>
Gurabo Abajo RG (GARP4)	1.10	4.58	2.97	1.23	<b>9.88</b>
Bo. Beatriz RG (BZDP4)	0.50	4.19	4.32	0.85	<b>9.86</b>

<b>Rio Jauca at Paso Palma (JAPP4)</b>	0.55	5.62	1.81	1.44	<b>9.42</b>
<b>Canaboncito RG (CAHP4)</b>	0.85	3.61	4.35	0.36	<b>9.17</b>
<b>Adjuntas 2 NW (ADKP4)</b>	1.22	3.73	2.07	2.03	<b>9.05</b>
<b>R. Gde. De Arec. – Utuado (UTXP4)</b>	1.91	2.67	2.33	2.11	<b>9.02</b>
<b>Rio Turabo abv Borinquen (CAKP4)</b>	0.40	4.91	2.55	1.07	<b>8.93</b>
<b>Bo. Consejo nr Adjuntas (ADNP4)</b>	1.21	4.45	1.81	1.34	<b>8.81</b>
<b>Rio Yunes at Hwy 140 (ADMP4)</b>	1.23	4.51	1.78	1.23	<b>8.75</b>

River flooding from this event was significant but actually quite ordinary by Puerto Rico standards and was considerably less than during Tropical Storm Jeanne in September 2004. The rainfall and subsequent flooding was also somewhat less than occurred in November 2003, which affected a larger area and had higher rainfall amounts. Eighteen (18) river gage locations in Puerto Rico (out of over 60 locations with defined Flood Stages) exceeded Flood Stage (see NWS E-3 Report for crest details) and of these only three (3) reached Moderate Flood Stage and one (1) Major Flood Stage. This occurred at Rio De La Plata at Comerio (COMP4), where records have been kept for only 15 years, so this may be subject to revision as more data becomes available. Return period data where available shows that the largest basin discharges were less than a 10-year frequency and most less than 5-year frequency. Despite this, initial reports indicated that there was considerable damage and impact on the island with this event, highlighting the vulnerability of island infrastructure to even fairly high-frequency events.

A welcome break in the very wet pattern became established for several days after the passage of a cool front on the 16 November. By the 19 November the diffuse front was drifting back northward with an increase in moisture and instability and enhanced shower activity. Rainfall was heaviest during the 24-hours ending at 1200 UTC on 21 November, and was primarily centered on the north central basins that saw heavy rain the previous week. Rio Bayamon (BAYP4) had 3.05"; Rio Guadiana (NAMP4), 2.82"; Arecibo 9 SW (ARBP4), 2.10"; and Rio Tanama (ARDP4), 1.91". Urban and Small Stream Flood Advisories were issued for 13 municipalities in the early morning hours of 21 November and an additional 18 later in the morning. Flood Warnings were also issued for portions of the Rio Cibuco, Rio De La Plata, and Rio Grande De Manati, all of which exceeded flood stage for a period of time. PREMA reported that flooding from the Rio Cibuco closed a stretch of Highway 2 between Vega Alta and Vega Baja and also Routes 675 and 676. The crest of 16.08 feet at Vega Baja (VGBP4) was actually slightly higher than during flooding the previous week.

The last third of November brought a period of highly welcome relief from the persistent rainfall and allowed for some drying of soils across Puerto Rico. However, even in the absence of significant rainfall several large landslides were observed, most notably in Manati on 23 November. This landslide, which occurred days after the end of heavy rains, destroyed or severely damaged eight homes in the Los Rosales Urbanization, fortunately no one was hurt.

#### Non-Routine Hydrologic Products Issued:

Hydrologic Outlooks (SJUESFSJU):	0
Flood Watches (SJUFFASJU):	8
Flood Warnings (SJUFLWSJU):	41
Flash Flood Warnings (SJUFFWSJU):	38
Urban/Small Stream Flood Advisories:	88

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cc: USGS Caribbean District  
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